

Study on the Germination of *Paulownia Tomentosa* Seeds in Different Provenances and Its Cluster

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Abstract This paper dealt with the studying the germination percentage, germination potential and analyzing the germination of the seeds with different treatments by systematic statistics method. Seeds were collected from 14 provenances in September 1994. The results indicated that the germination percentage and germination potential of the seeds in various provenances were different. Both indexes in Nanchang area was much lower than those in the rest provenances. The germination percentage and germination potential of the seeds in different provenance declined after the seeds were treated with aging for one year. The light treatment might promotes the germination percentage more effectively than the germination potential. In addition, fuzzy cluster may reflect the relationship among germination in different provenances.

Key words: *Paulownia tomentosa*, Seed, Germination, Cluster

Introduction

Paulownia tomentosa is one of the fastest growing trees and spreads in most provinces of China, but the same character in different area is various. The physiology and ecology of the tree have been studied mostly. However, the paper on the germination state and the relation of the seeds among provenances has not been reported so far. In order to understand the germination of *Paulownia tomentosa* seeds in different provenance and instruct forestry production, we carried out the following experiment and analyzed the cluster of the seeds with different treatments.

Materials and Methods

Materials are the wind dry seeds of *Paulownia tomentosa* in physiological mature, which were collected in 1994 from Henan, Shandong, Shanxi, Shaanxi, Hubei, Anhui, Jiangsu, Jiangxi Provinces of China. The new seeds are the ones tested in 1994, and the aged seeds are the ones stored at room temperature and tested in 1995. Seeds with different treatments germinate in artificial climatic chamber in which temperature is (30 ± 2) °C after being immersed in tap water for 3 days. Light condition of germination: 16 h/d, 6000 Lx light intensity. After the germination, germination percentage and germination potential were calculated. The cluster method refers to Land Kujian.

Results and Analysis

The germination percentage and germination potential of *P. tomentosa* seeds with different treatments

The germination percentage and germination potential of the seeds with different treatments are various (Table 1).

Table 1. The seed germination state of *P. tomentosa* in different areas under various conditions*

Areas	Code	Germination Percentage				Germination Potential			
		NSL	NSD	ASL	ASD	ASL	NSD	NSL	ASD
Huozhou	1	95.8	88.7	78.5	25.1	47.8	66.5	74.2	5.3
Anqing	2	96.9	87.0	70.9	24.2	45.3	15.3	70.3	4.2
Qianxian	3	95.9	84.5	62.4	23.4	35.9	42.3	63.7	4.1
Shijiazhuang	4	95.1	88.8	74.5	25.0	41.4	39.7	51.9	2.7
Taiyuan	5	96.2	84.6	80.7	26.1	68.7	30.8	59.9	1.1
Jinan	6	96.0	90.0	73.8	20.5	48.3	37.6	55.9	1.0
Sanmenxia	7	96.3	88.3	79.0	20.7	62.8	33.3	63.4	2.1
Houma	8	96.0	91.0	74.3	19.8	59.4	38.4	67.4	0.5
Tongling	9	98.7	86.9	59.8	12.5	51.0	31.3	69.5	0.4
Zhengzhou	10	97.5	88.7	66.5	23.2	50.7	39.9	59.2	0.5
Weinan	11	96.3	80.7	63.6	20.0	53.2	33.3	61.0	1.0
NanJing	12	91.1	82.9	63.7	20.1	52.0	42.1	53.7	0.2
Wuhan	13	92.4	87.4	64.4	18.1	47.7	36.5	55.0	0.1
Nanchang	14	93.3	82.3	45.0	15.6	22.3	37.6	51.7	0.0

* NSL: germination of the new collected seeds in light; NSD: germination of the new collected seeds in darkness ASL: germination of aged seed in light; ASD: germination of aged seed in darkness

The germination percentage of the seeds from the

same provenance under light condition is higher than that in darkness. The difference of the germination potential of the seeds with light and darkness treatments is very obvious, so is the aged seeds. Comparing the germination percentage and potential of new and aged seeds of *P. tomentosa*, we find out that aging treatment reduced the vigor of the seeds. This means that the seeds in light germinate better than in darkness, natural aging reduced the germination and potential of the seeds. So do the seeds in different provenance. Those might be resulted from *Paulownia* tree' adaptation of the inhabitant where it grows.

The cluster of the seeds in different provenance

System cluster The system cluster results of germination percentage and germination of the seeds in

different provenances (Fig. 1) indicate that the tree maps vary with cluster methods. According to the distribution of the *Paulownia* trees, we classify the provenances into four groups. Table 1 and Fig. 1 indicate that some group includes ten provenance, some only one provenance. Among the four groups, seeds from Huozhou provenance is one group all along. This mean the vigor of the seeds in this provenance is much different with the rest. Seeds from Shijiazhuang, Taiyuan, Houma, Sanmenxia, Zhengzhou, Jinan provenance may be in one group (e.g. the longest distance and sum square of deviation method), some of those as well as may be in another group (e.g. the shortest distance, variable distance, middle distance and center method). These results might be related to the vitality of the seeds and as well as to the systematic statistics method.

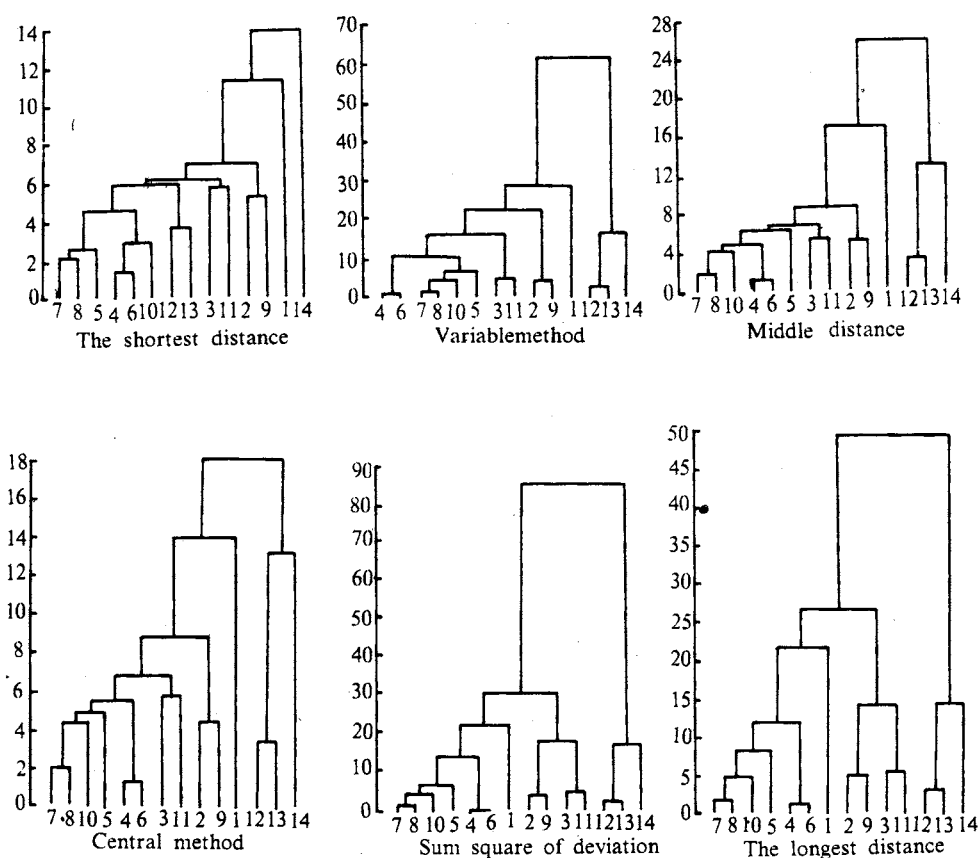


Fig. 1. Tree map of the seed systematic cluster

Fuzzy cluster The equivalent matrix (Table 2) is gotten based on the evaluation of the germination percentage and germination potential of the seeds in Table 1. If λ values are controlled at equal to 0.98, 0.93, 0.86, 0.83, 0.81, 0.79, 0.64, 0.40 respectively, fuzzy cluster map is as Fig. 2. Then the germination of the seeds in 14 provenances may divided into four groups as fol-

lows:

A{Taiyuan, Sammenxia, Huozhou}	λ	\in
[0.98,0.93]		
B{Zhengzhou, Houma}	λ	\in
[0.86,0.83]		
C{Anqiny, Qianxian, Shjiazhuang, Jinan, Tongling, Weinan}	$\lambda \in$	[0.81,0.79]

D{Nanjing, Wuhan, Nanchang} $\lambda \in [0.67, 0.40]$

Table 2. the equivalent matrix of seed germination in different

1	1																		
2	0.81	1																	
3	0.79	0.79	1																
4	0.73	0.73	0.79	1															
5	0.93	0.81	0.79	0.73	1														
6	0.74	0.74	0.79	0.74	0.74	1													
7	0.93	0.81	0.79	0.73	0.98	0.74	1												
8	0.83	0.81	0.79	0.74	0.83	0.74	0.83	1											
9	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	1										
10	0.86	0.81	0.79	0.73	0.86	0.74	0.86	0.81	0.71	1									
11	0.79	0.79	0.79	0.73	0.79	0.74	0.79	0.79	0.71	0.79	1								
12	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	1							
13	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	1						
14	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	1					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14					

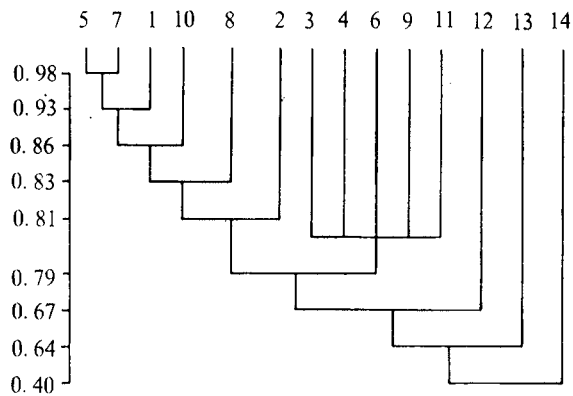


Fig. 2. Fuzzy cluster of the seed germination

From the results mentioned above, it can be seen that A and B include seeds having high vigour, but D is on the contrary. C includes vigor seeds, as well as lower vigor ones. This may results from the different micro-climate from where the seeds collected¹ whereas which mirrors the tree growth in these areas

Discussion

Environmental factors have effects on the seed vigor. The germination percentage and germination potential of *P. tomentosa* seeds vary with different provenances.

Light is advantageous to the germination of the seeds. The germination percentage and germination potential of the seeds stored at room temperature decline with the time. But mechanism that light promotes germination of the seeds and its optimum storage condition need to be studied further.

the results presented in this paper indicates that system cluster does not reflect the tendency of the seed germination, but the fuzzy one might mirror the basic tendency based on the meteorological, soil and other factors comprehensively. That is to say, fuzzy relationship might exist among the germination of the seeds in different provenance.

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